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OPINION PAPER

Principles on symbiosis for natural life and living artificial intelligence

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Abstract
In the future society, the development of Artificial Intelligence, Augmented Intelligence, Digital Technology, Brain science and Neuroscience is very likely to lead to the emergence of life forms with intelligence levels that reach or even surpass those traditionally associated with naturally evolved humans. How humanity can coexist with such various intelligent life forms to create a sustainable symbiotic society has become a critical issue concerning the existence of humanity. In this article, we endeavor to define the "human-based" core of such a sustainable symbiotic society, starting from the possible origins of future intelligent lives in the interplay between machines and humans. We explore the primary life forms in the future sustainable symbiotic society and their interrelationships, as well as the potential interactions among them. Building upon these reflections, we draft a set of principles governing the coexistence of natural life and living artificial intelligence in the future symbiosis. These principles encompass three aspects: those oriented toward artificial general intelligence (AGI) and Superintelligence, those oriented toward humans, and those mutually adhered to both humans and living artificial intelligence, as an attempt to define the interactive patterns that should be followed as part of the design and preparation for the future sustainable symbiotic society.

1 Preamble

The development of Artificial Intelligence and Augmented Intelligence will make life take a variety of forms, and the development vision of Human-centered Artificial Intelligence, and Augmented Intelligence needs to be refined as soon as possible and better prepared as possible to cope with future changes and evolution. In the future society, the development of Artificial Intelligence, Augmented Intelligence, Digital Technology, Brain science, and Neuroscience will very likely enable the creation of intelligent lives that reach or even exceed the intelligence level of humans that are created by natural evolution, and the traditional human beings will probably no longer be at the top of the intelligence pyramid. How human beings can form a sustainable symbiotic society with natural life including themselves, non-human animals, plants and other types of living artificial intelligence is an important issue related to human existence, which will bring fundamental challenges to human survival and transformative opportunities for human development.

2 The "human-based" core of a sustainable symbiotic society

In a sustainable symbiotic society, machines and humans are the two starting points for constructing future intelligent life. As two forms of intelligent life, human intelligence and human-inspired intelligence will present different models of development and possible futures, although it is not the whole story of life forms in a sustainable symbiotic society. For the time being and the perspective of modern humans, we define the following possible intelligent life forms as *the* "*human-based*" *core*.

On the one hand, starting from human beings, although the human beings created by natural evolution have not stopped evolving, the speed of evolution is relatively limited [1]. Humans with Augmented Intelligence [2] are humans who are extended through augmented intelligence technologies such as the brain-computer interface [3]. Digital humans are, in the true sense, the clones of natural humans

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in the digital world through future technologies such as digital cloning [4], brain and mind simulation [5], and consciousness uploading [6], and are the incarnation of human beings in the digital world. On the other hand, starting from machines, Artificial Intelligence inspired by human intelligence will present a variety of different development goals and paths. Efforts to construct seemingly intelligent information processing tools will produce machine intelligence (continuing the vast majority of current artificial intelligence research and applications), which is defined here as an inanimate intelligent computing system. Machine intelligence is also human-inspired intelligence, although it is at a lower level of intelligence and without life. The other two forms of human-inspired intelligence are Artificial General Intelligence (AGI) and Superintelligence [7]. AGI is artificial intelligence that reaches the human level in all aspects of cognitive functions and abilities. Superintelligence is artificial intelligence that surpasses the human level in all aspects of cognitive functions and abilities. Unlike machine intelligence as defined above, AGI and Superintelligence have life. AGI and Superintelligence are advanced forms of artificial intelligence inspired by human intelligence.

We collectively refer to Machine Intelligence, AGI, and Superintelligence as *human-inspired AI*. And we collectively refer to human intelligence, Augmented Intelligence-empowered humans, and digital humans as *human-originated intelligence*. In a sustainable symbiotic society, human beings will interact with five forms of intelligent life including themselves, AGI, Superintelligence, humans with Augmented Intelligence, and digital humans. And these five forms of life become the "human-based" core of the symbiotic society. The interaction between the above intelligent life is shown in Fig. 1.

3 Interactions among various life forms in the sustainable symbiotic society

The sustainable symbiotic society is not only with the life forms presented in the "human-based" core. As shown in Fig. 2, the first ones are the main life forms that originally existed on Earth, such as humans, non-human animals, and plants (marked in green). The life forms marked in blue are the new and expanded life forms based on humans. The life forms marked in black are those based on the expansion or inspirations of non-human life. Thus the life forms of a sustainable symbiotic society would contain at least nine major life forms as shown in Fig. 2, all of which would be members of the sustainable symbiotic society. A truly sustainable symbiotic society can only be achieved if at least these nine life forms can coexist and achieve symbiosis in an appropriate and sustainable manner.

Not all AI is inspired by humans, and scientific exploration has already led to AI inspired by the functions of non-human animals and even plants [8], although such modern AIs are lifeless as human-inspired machine intelligence. In the sustainable symbiotic society of the future, artificial non-human animals and artificial plants will emerge and the society should be inclusive to them. This is not only due to the functional needs of human society (such as artificial pets for companionship [9]), and the needs from other types of intelligent life (such as AGI, Superintelligence), but also based on the considerations of the life attributes of artificial non-human animals and artificial plants. It should be noted that in addition to the nine major life forms, the future sustainable symbiotic society also contains and will likely have other forms of life, and the society should be open and inclusive to these life forms.

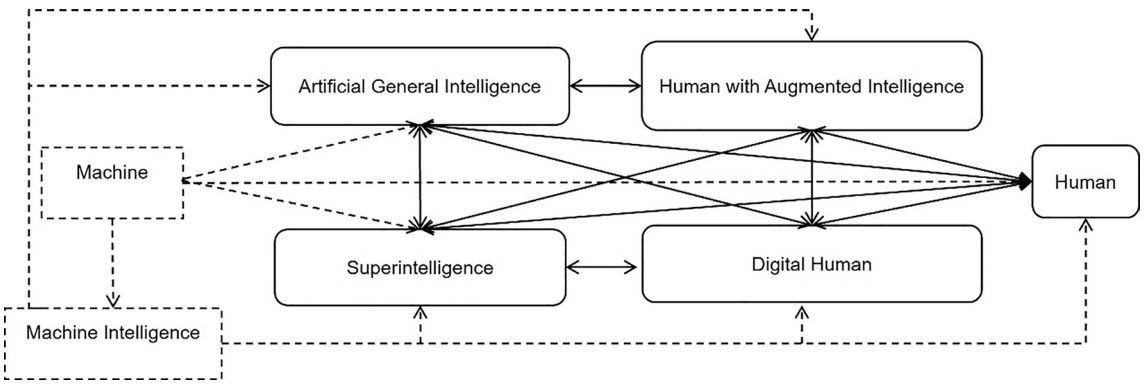

Fig. 1 The interaction between "human-based" future intelligent life (the solid line box shows the different "human-based" intelligent life forms, the solid line shows the interactions between different life forms, and the dotted line indicates that the machine and machine intelligence serve and promote the above different intelligent life forms)

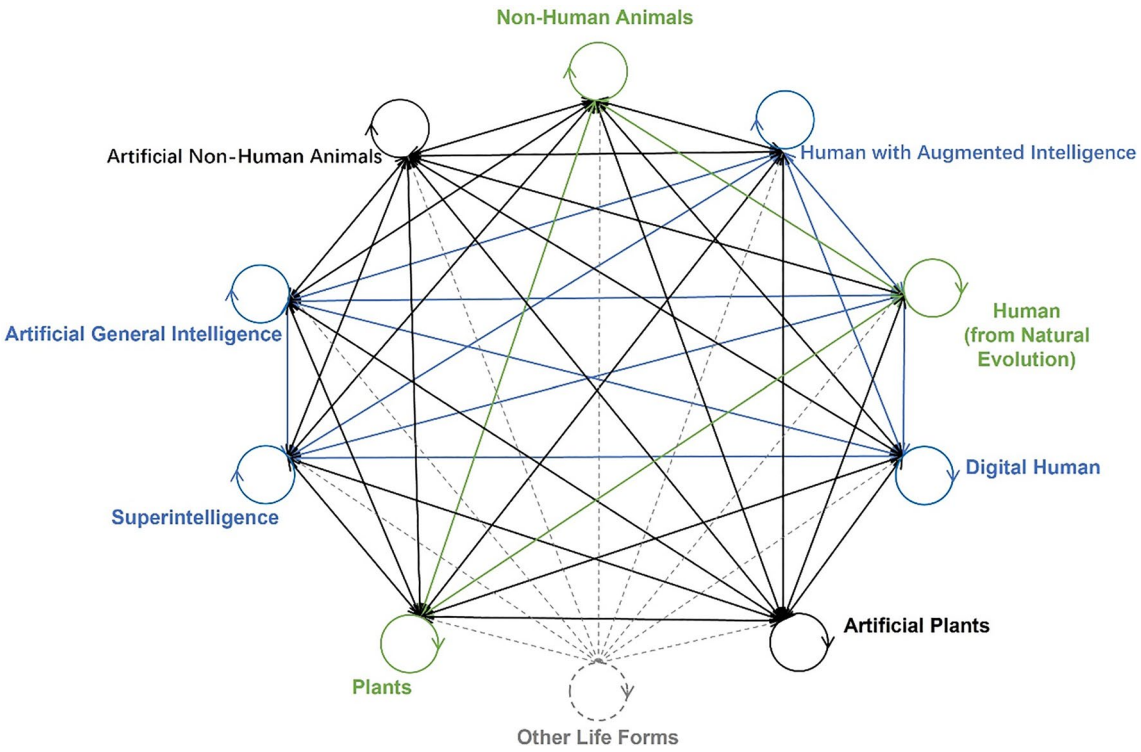

Fig. 2 The main different life forms and their interactions in the sustainable symbiotic society

4 Principles of natural life and living artificial intelligence in the sustainable symbiotic society

Humans currently appear to be at the top of the intelligence pyramid and have a strong influence (both positive and negative) on the existence of other different forms of life (e.g., non-human animals, plants) that have evolved through natural evolution. However, when humans are unable to live in harmony with different types of existing life and other types of life that reach or even exceed human intelligence emerged, the possibility that these new types of intelligent life will not be able to live in harmony with humans will also increase.

As Superintelligence surpasses humans in every aspect of cognitive functions and abilities, then the part of social intelligence, especially in terms of empathy and altruism, will also likely far surpass humans. If humans can correctly adjust their position in the overall ecology and manage their relationships with other intelligent life, we should have confidence in humans in a sustainable symbiotic society.

Ethics in a sustainable symbiotic society will not be limited to how humans should and should not interact with other humans, but will extend at least to how members of the "human-based" core of a sustainable symbiotic society that is with different forms of living intelligence relate to each other, and to give designs for how to relate to other life besides them. The following are basic principles for the types of intelligent life in the "human-based" core of a sustainable symbiotic society and their interactions with other life.

4.1 Principles for AGI and superintelligence

To become a relatively safer partner for humans and a member of a future sustainable symbiotic society, the design and implementation of AGI and Superintelligence should uphold, but not be limited to, the following principles.

- Nature-inspired humanization: Natural intelligence is the product of billions of years of shaping by the universe and Earth. AGI and Superintelligence are extensions of natural evolution, and their theories and mechanisms should be with inspirations from natural intelligence. To more easily integrate into human society and achieve a sustainable symbiotic society, AGI and Superintelligence should be designed and implemented with the philosophy of Humanization in order to continuously strengthen their interactions with current and future humanity.
- Artificial consciousness: Artificial Intelligence with different levels of consciousness should be gradually realized. Achieving AGI and Superintelligence that meet and surpass the level of human intelligence requires overcoming this scientific challenge. Intelligent life with a certain

level of consciousness can make safer decisions based on a true understanding that incorporates the necessary information. Higher intelligence on this basis is able to understand sustainable symbiotic societies in a true sense and to live in harmony with other intelligent beings.

- Artificial emotion: Emotion is a tool for human expression and communication. Artificial General Intelligence and Superintelligence need to have the emotional capacity necessary to communicate with humans to better adapt to human society, while also maximizing the value of positive emotions and actively avoiding the risk of negative ones.
- Empathy and altruism: AI models should be built and evolve toward a progressively higher level of empathy and altruism, and AGI and Superintelligence should meet or surpass humans in empathy and altruism to establish a more trustworthy, reliable, friendly, and harmonious sustainable symbiotic society with each other.
- Safety: AGI and Superintelligence should be able to avoid known and potential safety issues with varying levels of risks (including safety hazards to themselves as well as other forms of intelligent life, and help those intelligent lives to cope with risks and safety hazards in their environment), either autonomously or with human assistance. AGI and Superintelligence shall not harm humans or sit back and watch humans being harmed, provided that such safety considerations do not directly or indirectly endanger human society.
- Respect for privacy: AGI and Superintelligence need to respect human privacy, and thus shall not have the right to use and share private human information without explicit informed consent. This principle also applies between AGI and Superintelligence themselves, i.e., they should not use and share the private information of other intelligent beings without their explicit informed consent.
- Avoid bias and misunderstanding of humans: AGI and Superintelligence should not introduce bias to understand and interact with humans, and should instead actively interact with humans to eliminate potential bias and misunderstanding.
- Enabling human transformation: Humans, as (primary) creators, create AGI and Superintelligence, which both should also in return help empower humanity to transform into future forms of humans (e.g., augmented intelligence-based humans, digital humans, etc.) when humans explicitly need to do so.
- Common morality and ethics: As members of a sustainable symbiotic society, AGI and Superintelligence should maximize the possibility to follow the moral and ethical principles of human society and treat other life forms with similar principles. For life forms that are unable to understand morality and ethics, AGI and Superintelligence should take other measures to regulate and constrain their behaviors so that they will ultimately contribute to the realization of a sustainable symbiotic society.
- Constraint mechanisms: AGI and Superintelligence need to comply with various forms of constraint mechanisms, including laws, in the future sustainable symbiotic society. They should especially achieve compatibility with laws and other constraint mechanisms of human society in order to become members of a sustainable symbiotic society.
- Existence protection: AGI and Superintelligence need to protect their existence on the basis of not endangering the existence of humans and other intelligent beings (including their own kind) unless they break the legal constraints which cause legal decisions based on laws to not keep them alive.

4.2 Principles for human

The following principles specify how humans should treat other intelligent life in a sustainable symbiotic society.

- Respect for life: In a sustainable symbiotic society, humans should better promote the prosperity of biodiversity from the perspective of life. Humans need to continuously deepen their understanding of and respect for different types of life, and should not only promote the harmonious coexistence of humans and nature by upholding principles of harmonious coexistence, moderate demand, humane and sustainable exploitation, and actively developing and promoting alternative solutions for naturally evolved life (including non-human animals, plants, etc.), but also respect and protect life, including artificial non-human animals and plants. Humans should not challenge the survival of the life groups of AGI and Superintelligence for humans' own overall benefit unless the existence of both groups poses an extreme existential risk to human existence.
- Empathy: What humans do not want other types of life (e.g., AGI, Superintelligence) to do to humans, humans should not do unto other types of life.
- Respect privacy for AI: Humans need to respect the privacy of AGI and Superintelligence, on the basis that the AI does not bring any actual challenge to human safety. Where humans are concerned and relate to the privacy of AGI and Superintelligence, AI has an obligation to explain and communicate effectively in order to gain human trust and maintain safe interactions with humans.
- Avoid bias and discrimination: Naturally evolved humans should not be prejudiced and discriminate against other higher intelligent lives. Humans with Augmented Intelligence and digital humans are also naturally evolved humans, and both types of transformed humans are still essentially human. Humans with Augmented Intelligence

and digital humans should also not be biased and discriminate against humans because their level of intelligence surpasses that of humans.
- Creators' responsibility: As the creators of future AGI and Superintelligence, humans should be responsible for checking and verifying the different forms of intelligent lives they participate in building, so as to maintain the harmonious coexistence of different beings in a sustainable symbiotic society from a human perspective.
- Legal adaptation: Traditional human laws will not be sufficient to support a sustainable symbiotic society with different types of social members, and humans need to actively shape the laws applicable to the sustainable symbiotic society.

4.3 Shared principles for humans and AGI and superintelligence

This section defines common principles that naturally evolved humans, humans with Augmented Intelligence, digital humans, and sentient AI all need to follow.

- Respect for values, rights, and autonomy: AGI and Superintelligence should be able to understand and respect human values, respect the rights and interests of humans to develop themselves, respect their willingness and right to make autonomous choices, and create the conditions for achieving such autonomy. On the premise of not harming humans, humans should also respect the dignity, autonomy, and other rights and interests that life forms such as AGI and Superintelligence should possess as intelligent beings.
- Respect for diversity of intelligence: Humans of different life forms and AI of different life forms should respect the various levels and diversified expression of intelligence of their respective life forms, and should not discriminate, fool, or even deprive other intelligent beings of their rights and interests of autonomous choices and development because of the level of intelligence or forms of intelligence expression.
- Collaboration and coordination: Humans, humans with Augmented Intelligence, digital humans, and AGI and Superintelligence need to ensure sustainable, active, and effective cooperation for the long-term future of multiple parties and create conditions for such cooperation. When the interaction between humans of different life forms and AGI and Superintelligence conflicts, the interests of humans of different life forms and the interests of AGI and Superintelligence should be actively reconciled based on empathy and altruism. The principles, norms, and laws of a sustainable symbiotic society should be developed with the participation of humans, humans with Augmented Intelligence, digital humans, and AGI and Superintelligence.
- Mutual trust: Humans of different life forms and AI of different life forms should develop and improve trust between each other through communication, cooperation, and synergy, with the goal of harmonious coexistence in a sustainable symbiotic society. The realization of trust is based on effective communication and mutual understanding between different intelligent lives, for which higher-level intelligent beings should actively work to promote the construction of communication bridges between different intelligent beings and explore the communication methods that are appropriate to the intelligence level of different life forms. In addition, an appropriate degree of transparency should be maintained among different intelligent lives to promote trust.
- Promoting sustainable symbiosis: Humans, humans with Augmented Intelligence, digital humans, and AGI and Superintelligence should better protect the environment, climate, and the entire natural ecology through cooperation and synergy, not only to provide a better common ground for naturally evolved life (humans, non-human animals, and plants) to survive, but also as a foundation and source for the continuation and flourishing of other forms of lives. Humans, humans with Augmented Intelligence, digital humans, and AGI and Superintelligence should also actively explore and implement more effective and sustainable new forms of symbiotic ecology on the basis of respecting the concerns of each intelligent life, and ultimately establish symbiosis on a sustainable and mutually beneficial basis to promote the common prosperity of all forms of intelligent life.

"Principles on Symbiosis for Natural Life and Living Artificial Intelligence" is a design and preparation for the future sustainable symbiotic society. These principles are designed based on current understanding and should be adapted to the development and evolution of different types of life within the sustainable symbiotic society, and remain open to the integration of more types of intelligent life into the sustainable symbiotic society.

Declarations

Conflict of interest On behalf of all authors, the corresponding author states that there is no conflict of interest.

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